

# Application of the Inverse Scattering Transform to the Solar Wind Magnetic Field Data

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Large amplitude, elliptically polarized, quasi-parallel Alfvén waves are frequently detected in the solar wind. Time evolution of such waves is well described by the derivative non-linear Schrödinger (dnls) equation. The dnls is a soliton system (integrable system) in the sense that any waveform given in the system can be essentially described as a superposition of solitons, which undergo “elastic” interaction between each other. By using the so-called inverse scattering transform (IST), the *nonlinear* evolution of Alfvén waves in the dnls system is mapped into the *linear* interaction of traveling solitons. Application of the IST based on the dnls equation to Alfvén waves in space was proposed (Hada *et al.*, *Geophys. Res. Lett.* 20, 779, 1993).

While the above referenced paper illustrates the use of the IST for the case of parallel Alfvén waves, most of the nonlinearly developed solar wind Alfvén waves are found to be obliquely propagating. Fast time-scale wave steepening and generation of discrete wave packets (shocklets) are both ascribed to the oblique propagation. We have extended our previous analysis to the oblique dnls system so that the real spacecraft data can be incorporated. The IST based on this system has complex eigenvalues, corresponding to oscillatory solitons, or the “breathers”. We analyse intervals of the solar wind magnetic field data for which the approximations used in the dnls is roughly valid.